

WE CLAIM:

1. A method for centering a workpiece on the central axis of a cylindrical bore in a body, the workpiece including a rod, the method comprising:

5 (a) inserting into an end of the bore an arbor having a cylindrical exterior surface matingly slidable within the cylindrical bore, the arbor having a symmetrical reference pin protruding from an end of the arbor coaxially with the central axis;

(b) sensing the position of the reference pin in a plane transverse to the central axis and transmitting pin position data to a computer system;

10 (c) computing a center of the reference pin from the pin position data and representing the reference pin center as a bore axis target;

(d) removing the arbor from the bore and inserting the workpiece into the bore with the rod protruding from the end of the bore;

(e) sensing the position of the rod in the plane transverse to the central axis and transmitting
15 rod position data to the computer system;

(f) computing a center of the rod from the rod position data and representing the rod center as a rod target; and

(g) adjusting the position of the rod to bring the rod target substantially coincident with the bore axis target.

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2. The method in accordance with claim 1, wherein the position of the reference pin and the position of the rod are electromechanically sensed.

3. The method in accordance with claim 1, wherein the position of the reference pin and the position of the rod are optically sensed.

4. The method in accordance with claim 3, wherein the position sensing comprises generating and transmitting a beam of light from each of a plurality of light transmitters across the central axis to cooperating light receivers, the reference pin and rod casting a shadow upon the opposing receivers to provide an indication of the location of the reference pin or the rod with respect to the central axis.

5. The method of claim 4, wherein two light beams are transmitted orthogonally across the central axis between two cooperating pairs of light transmitters and light receivers

6. The method of claim 4, wherein the light transmitters incorporate light emitting diodes to generate the beams of light and the light receivers are charge coupled devices.

7. The method in accordance with claim 1, wherein the bore is a bore of a free piston machine, the workpiece is a connecting rod of a free piston machine, and a displacer is positioned at a distal end of the connecting rod and substantially centers the distal end of the connecting rod within the bore.

8. A workpiece positioning system for centering a workpiece on the central axis of a cylindrical bore in a body, the workpiece including a rod, the system comprising:

(a) an arbor having a cylindrical exterior surface sized to matingly slide within the cylindrical bore, the arbor having a symmetric reference pin protruding from an end of the arbor for insertion in the sleeve;

(b) a location determining system for identifying the location of the reference pin in the bore and generating a pin position signal, and for determining the location of the rod when inserted in the bore and generating a rod position signal; and

(c) a computer system for receiving the pin position signal and the rod position signal, computing the center of the bore from the pin position signal and computing the location of the center of the rod from the rod position signal, and indicating when the center of the bore and the location of the center of the rod are substantially coincident.

9. The system in accordance with claim 8, wherein the location determining system includes at least one position transducer to mechanically sense the position of the reference pin and the position of the rod and generate an electrical signal representative of the position.

10. The system in accordance with claim 8, wherein the location determining system includes a plurality of position detectors, each position detector having a light transmitter spaced from a cooperating light receiver for transmitting a beam of light across the central axis to an opposing light receiver, the position detectors being angularly spaced about the axis such that when the reference pin or the rod interferes with the light path, a shadow is cast upon the opposing receiver providing an indication of the location of the reference pin or the rod with respect to the central axis.

11. The system in accordance with claim 10, having a first light transmitter, a second light transmitter, a first light receiver cooperating and opposing the first light transmitter, and a second light receiver cooperating and opposing the second light transmitter, the first light transmitter generating and transmitting a beam of light across the central axis that is orthogonal to the beam
5 of light generated and transmitted by the second light transmitter.

12. The system of claim 10, wherein the light transmitters incorporate light emitting diodes to generate the beams of light and the light receivers are charge coupled devices.

10 13. The system in accordance with claim 8, wherein the bore is a bore of a free piston machine, the workpiece is a connecting rod of a free piston machine, and a displacer is positioned at a distal end of the connecting rod and substantially centers the distal end of the connecting rod within the bore.